

For Reference

NOT TO BE TAKEN FROM THIS ROOM

For Reference

NOT TO BE TAKEN FROM THIS ROOM

Ex LIBRIS
UNIVERSITATIS
ALBERTAENSIS





Digitized by the Internet Archive
in 2019 with funding from
University of Alberta Libraries

https://archive.org/details/Hare1960_0

Thesis
1960
#18

THE UNIVERSITY OF ALBERTA

AN INVESTIGATION OF
THE RELATIONSHIP OF THE LEVEL OF ABSTRACTION
IN WRITTEN EXPRESSION TO INTELLECTUAL
ABILITY AND ACADEMIC ACHIEVEMENT

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS

DEPARTMENT OF PHILOSOPHY AND PSYCHOLOGY

by

ROBERT DOUGLAS HARE

EDMONTON, ALBERTA

MARCH 31, 1960

UNIVERSITY OF ALBERTA
FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read,
and recommend to the Faculty of Graduate Studies for
acceptance, a thesis entitled

AN INVESTIGATION OF THE RELATIONSHIP OF THE LEVEL
OF ABSTRACTION IN WRITTEN EXPRESSION TO INTELLECTUAL
ABILITY AND ACADEMIC ACHIEVEMENT

submitted by Robert Douglas Hare
in partial fulfilment of the requirements for the degree
of Master of Arts.

ABSTRACT

This study is an attempt to investigate the relationship of the level of verbal abstraction in written expression to intellectual ability and to academic achievement. More specifically, the following hypotheses were tested: 1) that the level of abstraction as measured by the Gillie(1957) formula is positively correlated with the SCAT V and Q; 2) that the level of abstraction and the degree of variation in this level from sentence to sentence are positively correlated with the final grade 12 average. A sample of 95 English 30 final examination papers (in which a given essay topic was written upon) was drawn from among those written by Alberta senior matriculation students in 1959. Both the level of abstraction (A_L) and the average change in level for 10 consecutive sentences (Variation) were computed from the essay, and were then used, in conjunction with the SCAT V and Q, the English 30 grade and the final average, to form a matrix of intercorrelations. The results tend to validate the hypotheses, for the Gillie A_L is correlated .53 with the SCAT V, .32 with the SCAT Q, and .52 with the final average; while the Variation is correlated .36 with the final average. These correlations are all highly significant ($p < .001$). Since the Gillie A_L , the Variation, and the SCAT V and Q are all intercorrelated, a set of regression weights,

using the final average as the dependent variable, was computed to determine the importance of each variable, outside of what it has in common with the other variables, in the prediction of the final average. The SCAT V was found to account for 34.35% of the predictive variance in the final average, the SCAT Q for 38.99%, the Gillie A_L for 14.46%, and the Variation for 12.30%. The proportions of the predictive variance accounted for by the Gillie A_L and by the Variation are significant ($p < .01$), and the conclusion is therefore reached that these variables contribute something to the prediction of the final average that the SCAT V and Q do not. The multiple r between these four variables and the final average was found to be .77, while the multiple r using only the Gillie A_L and the Variation turned out to be .57. Finally, by correlating the Gillie A_L and the Variation with the SCAT total, a multiple r of .63 is obtained; and by correcting for attenuation, there is some indication that R would be increased to over .70.

The results suggest that further research designed to follow up and extend the present findings may be warranted, and may prove to be of theoretical and practical significance, both to psychology and to education.

ACKNOWLEDGEMENTS

The assistance rendered by those concerned with this investigation is gratefully acknowledged. Special thanks must go to Dr. C. Uhl, whose able direction and constructive criticism are largely responsible for any merit the study may have; and also to the Department of Education for kindly making available examination papers, grades and SCAT scores. Appreciation must also be extended to my wife for her active assistance and continued encouragement.

TABLE OF CONTENTS

	LIST OF TABLES	vii
	INTRODUCTION	1
I	SURVEY OF THE LITERATURE	
	1. LANGUAGE AND COMMUNICATION	2
	2. GENERAL SEMANTICS	8
	3. CONCEPT FORMATION	10
II	THEORETICAL BASIS FOR THE STUDY	16
III	THE VARIABLES USED	24
IV	PROCEDURE	35
V	RESULTS	39
VI	DISCUSSION	51
VII	CONCLUSIONS	63
	BIBLIOGRAPHY	67
	APPENDIX	74

LIST OF TABLES

I	MATRIX OF INTERCORRELATIONS BETWEEN THE FINAL AVERAGE, ENGLISH 30, SCAT V AND Q, VARIATION, GILLIE, AND FLESCH	39
II	BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, WHEN THESE VARIABLES ARE USED TO PREDICT FINAL AVERAGE	41
III	THE TOTAL VARIANCE IN FINAL AVERAGE ACCOUNTED FOR WHEN THE SCAT V AND Q, VARIATION, AND A_L ARE USED AS INDEPENDENT VARIABLES, AS COMPARED TO WHEN THE VARIATION OR A_L IS OMITTED	43
IV	MULTIPLE CORRELATION COEFFICIENTS OBTAINED BETWEEN THE CRITERION (FINAL AVERAGE) AND SEVERAL COMBINATIONS OF INDEPENDENT VARIABLES	44
V	BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, AND THE FLESCH A_L , WHEN THESE VARIABLES ARE USED TO PREDICT FINAL AVERAGE	46
VI	BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, AND THE FLESCH, WHEN THESE VARIABLES ARE USED TO PREDICT ENGLISH 30 GRADES	48
VII	SUMMARY OF THE RESULTS MOST RELEVANT TO THE INVESTIGATION	50
APPENDIX		
I	THE SCORES OBTAINED BY EACH STUDENT ON THE DEPENDENT AND INDEPENDENT VARIABLES	74

INTRODUCTION

It has long been recognized that academic achievement is dependent upon many factors, including intellectual ability, motivation, personality, interests, etc. One factor that seems not to have been considered and which may be of considerable practical and theoretical importance, is the influence which verbal abstraction may have upon the comprehension and subsequent communication of academic material. Recent investigations by Flesch (1950) and Gillie (1957) have resulted in a statistical method of quantifying the degree or level of abstraction in written expression. It was therefore decided to employ this device to test the hypotheses, developed from an interest in general semantics and the psychology of language, that:

1. The level of abstraction in written expression is correlated with intellectual ability and with academic achievement.
2. The degree of variation in the level of abstraction is correlated with academic achievement.

For the purposes of this study the level of abstraction in written expression is taken to be the AL index as computed by the Gillie method; intellectual ability as the scores obtained on the SCAT V and Q; and academic achievement as the final grade 12 average received by matriculation students in the Alberta high schools in 1959.

CHAPTER I

SURVEY OF THE LITERATURE

Since the theoretical basis for this study has been derived from three related areas - general semantics, concept formation, and the psychology of language - the relevant sources of information from these areas are considered here, and an attempt is made later to integrate them.

1. Language and communication.

Language has long been considered by psychologists as one of the more interesting aspects of behavior. Miller (1951) says that no other activity gives the same insight into another individual as his verbal behavior. Sanford (1942a) reviewed past attempts to measure language, and concluded that "There is then, a reasonable argument, reinforced by some empirical evidence, that a quantitative analysis of written expression can discover individuality... It would appear that language, because of its complexity and apparent amenability to subtle quantification, recommends itself as a medium in which the analytical approach to individuality is likely to be most profitable." Johnson (1946) says that "One of the specific objectives of research in language is to determine the degree of correlation between various measures of language and other

pertinent variables, as those involved in environmental influences, physiological conditions, intelligence, and personality adjustment."

Since verbal ability appears to be of such extreme importance in our society it is not surprising that many investigations of language structure and usage have been carried out by psychologists. Although many of these studies have been concerned primarily with vocal expression, they are nevertheless deemed relevant to this study

Sanford (1942b) carried out a comparative case study on two male college students and found significant differences in the way each typically used vocal and written speech - differences in complexity, sentence lengths, use of different parts of speech, etc.¹

Balken and Masserman (1940) did a similar study using several types of neurotic patients. They observed that the verb-adjective ratio differentiated between these patients. For example, anxiety state patients had a higher ratio than conversion-hysteria patients.

The verb-adjective ratio was also used by Boder (1940) who found that it correlated significantly with emotional instability in children (as rated by teachers).

Chotlos (1944) worked with another measure of

¹ If results are not reported statistically, it is because they were not available to this writer.

verbal diversification, the type-token ratio (TTR), showing that it was positively correlated with intelligence in children. On the average, the written material for superior groups contained a higher TTR than did the material from the more inferior groups.

A widely used measure of writing style is the sentence length for which very consistent individual differences have been reported. Yule (1938) was able to show that the lengths of the sentences in the disputed "De imitatione Christi" were very nearly the same as those in the works of a Kempis, and were shorter than those used by Gerson. It was therefore suggested that a Kempis was the real author.

Miller (1951) has proposed that the standard deviation of the frequency distribution of an individual's sentence lengths could be used as a measure of "verbal change of pace."

A very relevant study was carried out by Buseman (1925). He analyzed the verbal productions of individuals from 5 to 18 years of age, for the proportion of qualitative or descriptive, as opposed to active or dynamic expressions, and showed that a low "action quotient" was related to emotional stability. Commenting on this study, Stern (1925) said that Buseman had actually shown that these differences in style depend very little on the subject matter being

dealt with. The person with a high action quotient tended to express himself in active terms even when describing a dull, passive landscape. The qualitative person, on the other hand, described everything as being devoid of action (even a bull-fight).

Another study, this one by Allport et al (1934) indicates that an individual may express himself in a relatively consistent manner. Allport tried to determine, in terms of style, which essays had been written by the same authors. Matching was considerably better than chance.

These investigations suggest that language is a useful psychological tool, and that it may be a rather reliable one in certain respects, especially style.

The attempts to measure readability are of major concern here, since the Gillie index of abstraction, used in this study, was indirectly derived from them. For this reason, a very brief survey of readability studies is here given.

Pioneer work in this area was done by such persons as Vogel and Washburne (1928) and Johnson (1930) the latter of whom proposed that the percent of polysyllabic words in writing could be used as a rough measure of readability. Other early attempts were made by Gray and Leary (1935) and Lorge (1939), but their measures were

quite cumbersome, requiring reference to word lists. Flesch (1943) developed a statistical formula for the measurement of readability or comprehension difficulty, based upon the average sentence length, and the number of affixes and references to people. The formula was revised in 1948, a reading ease score (RE) being determined by the average sentence length in words and the average word length in syllables; and a human interest score (HI) being determined by the percentage of personal words and sentences.

Since the principles used in the RE formula are somewhat similar to those used in the abstraction formulas developed later, several reports of its reliability and validity are given. Hayes, Jenkins and Walker (1950) found RE reliability coefficients of over .90 between those experienced and those inexperienced in the application of the formula. These results have been confirmed by England et al (1953) who also found the test-retest reliability to be from .95 to .99. Although validity is much more difficult to determine, several studies have indicated that it is fairly good. Swanson and Fox (1953) found that RE scores satisfactorily predict differences in comprehension difficulty between two versions of the same material, and Peterson (1956) observed that the RE formula adequately estimates the comparative difficulty in comprehension of "popular" reading material for a 17-18 year old

age group. However, Lockmann (1956) found that RE scores correlated only .52 with understandability when a highly selected group of aviation cadets was used.

A study very relevant to this one was carried out by MacKinney and Jenkins (1954). Four hundred contest letters written by members of the General Motors organization were analyzed with the RE formula. A highly significant relationship was found between the relative difficulty of the writing which an individual produced and his occupational level. The possibility, uncovered by these investigators, is that the difficulty of material which an individual is able to write is related to the difficulty of material he is able to comprehend.

In 1950, Flesch published a method for measuring the level of abstraction in writing. The difficulty in determining precisely which words and phrases represent abstraction had previously caused Gray and Leary (1935) to abandon their attempt at measuring abstraction. In devising his formula, Flesch utilized the fact "that certain parts of speech are more frequent in abstract expression, while certain other parts of speech are more frequent in concrete expression." Apparently no studies have been reported on the reliability and validity of this formula, outside of the comment made by Jenkins and Jones (1951) that as a measure of abstraction per se it seems to be of definite

value.

Because Flesch's formula for the measurement of abstraction was rather cumbersome, requiring the use of 16 substeps and 13 limitations, Gillie (1957) presented a modified version which he says "represents an attempt to simplify the measurement of abstraction by combining a few carefully selected elements related to abstraction in an experimental formula which can easily be applied to any writing material." This simplified formula was found to correlate .82 with the Flesch formula from which it was derived.

2. General Semantics

The Flesch index of abstraction (and presumably the Gillie) is, according to Flesch, a quantitative determination of the semanticists' more general "abstraction ladder;" and since this concept is of some importance to this study it is briefly outlined.

Korzybski (1933), one of the pioneers in the field of general semantics, postulated the existence of a sequence of events of increasing degrees of removal from reality. Hayakawa illustrates this in the following way (1949):

1. Submicroscopic level (reality) - the cow known to science, composed of an infinite number of characteristics.
2. Macroscopic level - the cow we see, consisting of

of the characteristics taken from the first level which it has in common with all other similar objects, i.e. cows.

3. The verbal level - the name (Bessie) given to the object. It stands for the object and omits many of the characteristics contained in the lower levels.
4. The word "cow" - composed of features common to Bessie and all other cows.
5. The word "livestock" - composed of features common to cows and other farm animals.

We can continue on up the ladder, using more and more abstract terms - farm asset, asset, wealth - in which more characteristics are left out and almost all reference to reality is omitted. It is clear that as progress is made up the ladder, successive abstraction occurs, i.e., sensory experiences become linked together, some details becoming dominant and others being left out. The symbolic response for these dominant details is the verbal concept (Vinacke 1952). For example, the dominant details for what Bessie has in common with other similar objects is covered by the verbal symbol "cow".

The semanticists tell us that people characteristically differ in the manner in which they handle verbal abstractions. Some individuals are stuck on a very high level of abstraction; others are bound to the lower, more concrete levels; while still others use considerable interplay between levels. Because of the relatively great degree of removal from reality that is encountered on the higher levels

of abstraction, words and expressions become very ambiguous and easily confused with the other levels. For example, Hayakawa (1949) says that many people confuse the very abstract word "Jew" with the more concrete "Mr. Miller", behaving as if Mr. Miller were identical with the high level abstraction "Jew". This leads the semanticists to suggest that both optimal adjustment and effective communication depend upon the individual's ability to vary the level of abstraction upon which thinks and acts. In other words, communication is most effective when abstract generalizations are alternated with referrals to the more concrete and "realistic" levels.

3. Concept Formation

Humphrey (1951) says "Relatively little research has been done on abstractive generalization at levels higher than the perceptual" in spite of the fact that "generality is found par excellence in language." But though little work has been carried out on the use and range of verbal concepts per se, the results obtained from studies on concept formation in general may be pertinent to this study. Since the terms abstraction, generalization and concept are used throughout this study, the relationships between them must receive some discussion, however superficial. Vinacke (1952) says that "Abstraction signifies the linking of one sensory experience to another, during

which some details are left out and others become dominant (in this sense the concept is a symbolic response for these details, as it is for the semanticists). Generalization signifies that the dominant detail (or group of details) resulting from abstraction is used as a basis for responding similarly to the separate objects linked by abstraction, and for responding to other objects similarly linked"(p.97). In general, the concept is "the cognitive structure which links the individual's present perceptions and learning to his previous experiences"(p.98). A verbal label symbolizing these relationships allows them to be manipulated in various complex ways.

The roles of abstraction and generalization in the formation of concepts are responsible for the two most prominent theories of concept attainment:

1. The composite-photograph theory - The successive abstraction of characteristics common to a class of objects leads to a concept in which the dominant details stand out and the variable details are dropped . This is similar to the "abstraction ladder".
2. The active-search theory - Generalization rather than abstraction is the important feature. The concept originates as a hypothesis which is then

tried upon new objects. There is an active search for the relationships and common characteristics involved.

A concept, once formed, may belong to any of a number of hierarchies; thus the verbal concept "cow" is subordinate to "animal". This of course corresponds with the "ladder of abstraction".

Graham(1938) reported that the ability to generalize is somewhat positively correlated with intelligence(ACE) and with scholastic averages in college.²

Smoke(1932) obtained a rank difference correlation of $+ .52$ between the ability to generalize and a test of intelligence.

Ewert and Lambert(1932) found correlations of from $+ .86$ to $+ .93$ between the scores on a intelligence test and those on a concept test that involved moving discs of graded size from one circle to one of two others, in such a way that the largest discs were always on the bottom. The correlation between performance and intelligence seemed to increase with the complexity of the task. Moreover "The more intelligent the subjects, the more they were able to deal with language symbols, and they rely more upon symbols as the particular problem increases in

² In many of these studies the type of test used was not reported in the references available.

complexity"(p.411).

However, Deutsche(1937) reported a correlation of only + .18 between a test of causal relationships and intelligence. Similar findings were made by Peterson(1936).

Several investigators, including Ordan(1945) and Deutsche(1937) have shown that there is a low correlation between scores on a concept test and socio-economic background. There was however, a good relationship between these tests and vocabulary and school grades.

Welch and Long(1942) have suggested that conceptualizing ability develops with age, and that the approach to concept formation changes from concrete to abstract. By using sorting tests, Reichard et al(1944) were able to list three levels of conceptual development appearing with age:

1. A concretist level where classification is made on the basis of non-essential, incidental features.
2. A functional level, where classification is made on the basis of utility, value, etc.
3. A conceptual level, where classification is made on the basis of abstract qualities and relationships.

Several investigators have observed that individuals differ in their approach to the formation of concepts, and in their subsequent use of them. Patients with aphasia were reported by Weigle(1941) and Golstein(1948) to exhibit concrete behavior in sorting problems. The speech

1. The first of these is the

fact that the majority of the

population of the country is

of the same race and language.

2. The second is the fact that

the majority of the population

is of the same race and language.

3. The third is the fact that

the majority of the population

is of the same race and language.

4. The fourth is the fact that

the majority of the population

is of the same race and language.

5. The fifth is the fact that

the

majority of the population is

of the same race and language.

6. The sixth is the fact that

the majority of the population

is of the same race and language.

7. The seventh is the fact that

the majority of the population

is of the same race and language.

8. The eighth is the fact that

the majority of the population

is of the same race and language.

9. The ninth is the fact that

of these patients is often bound to the concrete and the particular, with the ability to use abstract nouns being lost (Miller 1959).

Normal individuals seem to be able to take three different approaches to behavior - a primitive, concrete approach, an intermediate concrete-abstract approach, and a conceptual or abstract approach (Hanfmann and Kasanin 1937, Goldstein and Scheerer 1941). In this regard, Vinacke(1952) says that behavior appears to vary along a hypothetical dimension of concreteness-abstractness, with the possibility that most individuals tend to display predominantly a given pattern, at least in some situations. The concrete phase of behavior would be characterized by an inability to classify objects or events according to some property or principle, whereas the abstract phase would involve the ability to organize objects or events in terms of common properties. Moreover, there seems to be some evidence (Vinacke 1952) that the most efficient way to form concepts is to intermingle both abstract and concrete approaches, in much the same way that the most effective communication, according to the semanticists, involves variation between the levels of abstraction.

Most of the investigations of concrete-abstract behavior have been concerned with pathological cases. However, Vinacke (1952) says "...distinction between

concrete and abstract performance may have considerable significance for normal everyday behavior" (P. 128). The present investigation is an attempt in this direction.

CHAPTER II

THEORETICAL BASIS FOR THE STUDY

The Gillie formula for abstraction, like the Flesch formula from which it was derived, is ostensibly a means of measuring the degree or level of abstractness in writing. No satisfactory evidence for the validity of these formulas is available; however, on the basis of a discussion presented later,¹ the conclusion is reached that the Gillie formula is probably sufficiently valid for use in a theoretical study such as this, and that it may measure not only the level of verbal abstraction (the order or hierarchy of concepts), but also the range of verbal concepts employed in written expression. If such is actually the case, it seems reasonable to suggest that the range and order of concepts used should reflect, among other things, the range and order of concepts contained in the individual's conceptual repertoire. In this regard, Brown (in Bruner et al 1956) says "...speech is a system providing attributes for the entire conceptual repertoire..." (p.273). The Gillie formula for abstraction² may therefore be a measure of the range and order of concepts in this repertoire.

¹ See pp. 28

² Hereafter designated by AL.

If these assumptions are correct, the AL index should be rather well related to intelligence, for as we have seen, the ability to conceptualize, and hence the range and order of concepts, is correlated with intelligence (Ewert and Lambert 1932, Smoke 1932, and Deutsche 1937). In general, the more intelligent individuals will probably form more concepts (and of a higher order) than will those of lower intelligence, and will therefore tend to receive a higher score on the AL index of abstraction. In addition, several prominent theories of intelligence emphasize the importance of being able to abstract common properties, an ability which we suggest is reflected in the AL index. Russel(1956) says that "Terman spoke of intelligence as the ability to do abstract thinking involving the formation and use of concepts"(P.38). Thorndike has suggested that intelligence is composed of three factors, one of which is abstract or verbal intelligence involving the facility to manipulate symbols (Wechsler 1944). Moreover, both Spearman(1946) and Rimoldi(1951) consider one of the most essential factors in intelligence to be the ability to perceive common properties and relationships and to deduce correlates. And Vinacke(1952) comments that part "of the reason that mental age increases during the period of growth is that the ability to conceptualize increases"(p.119). Finally,

Bruner et al(1956) state that "...virtually all cognitive activity involves and is dependent on the process of categorizing"(p.246). We conclude that the AL index should be related to intelligence.

If the level of abstraction in written expression is indeed related to intelligence, then we might naturally assume that it will also be related, to a certain degree, to academic achievement, since most investigations on the validity of intelligence tests as a predictor of academic achievement have reported significant correlations. However, it is well established that intelligence tests used for this purpose leave much to be desired, especially at the upper grade levels where the student populations are more homogeneous. Super(1949), in a summary of data, notes that the correlation between intelligence and achievement in school usually ranges from $+ .20$ to $+ .70$, with the modal r being around $+ .30$ to $+ .50$. Clearly, other factors are involved - motivation, personality, interests, study methods, etc. In general, it may be that, all other things being equal, academic achievement is the combined result of comprehension of the subject matter and its subsequent communication to those concerned. How well material is comprehended depends upon many things, among them the ability to perceive and integrate the relationships between data and events, and between

information previously acquired and new problems. Of course this involves intelligence, as we have seen, but although there may be a large amount of overlap between conceptualizing and intellectual abilities, the two almost certainly are not identical. The study by MacKinney and Jenkins (1954) previously cited, is relevant here. It was suggested that the complexity of material which an individual writes (as determined by the Flesch Readability formula) may reflect the complexity of the written matter he is able to comprehend. In the same way, the ability to communicate relationships and to use verbal concepts, especially higher order ones, may be related to the ability to perceive these relationships and to form concepts. We have seen that the level of abstraction (as determined by the Gillie AL) is assumed to be an indicator of conceptualizing ability, and it consequently seems not unreasonable to suggest that the use of many relationships and higher order concepts, reflected in a high AL index, should be related to the ability to comprehend academic (and other) material. The AL index thus, while not in any way pretending to measure all or even most of the factors involved in the comprehension and communication of scholastic material, might conceivably account for some of them. For example, the individual who presents

his argument on a very concrete level with many disjointed facts may not have as good an understanding of the material as one whose argument is presented on a higher level of abstraction, showing an ability to manipulate and relate ideas and concepts into an integrated pattern. This may mean then, that the AL index is positively correlated with academic achievement.

If we consider academic achievement to be largely the result of comprehension and communication, as we have done, another possibility, derived mainly from general semantics, becomes apparent. This is, that in addition to an overall high level of abstraction, information, in order to be communicated most effectively, may have to be presented in such a way that the very abstract statements are qualified or emphasised by more concrete ones. Flesch (1950) says "According to Shannon's mathematical theory of communication, any noise hampering the transmission of a message is counteracted by redundancy in the message itself. By extension, any semantic noise (comprehension difficulty, ambiguity, etc.) is counteracted by semantic redundancy (repetition, padding, amplification, restatement etc.). In other words, information on a high level of abstraction, which is difficult to grasp, is communicated more effectively to the extent that restatements on a more concrete level are added. This of course corresponds to the use of illustrations, practical applications,

examples, parables ..." The statement is similar to Stuart Chase's (1954) quotation "of sending down piers of reality to solid earth lest the bridge of theory collapse". The semanticist Hayakawa (1949) agrees with this when he says that persons who never leave the very high levels of abstraction may fail to notice when they are saying something and when they are not, and the same lack of discrimination is produced in their audience. At these high levels, words are very ambiguous, conveying a great deal of meaning; a fact that is useful to those who know what they are talking about, but may be equally useful to those who are trying to cover up an obvious lack of knowledge through the use of abstract ambiguous language (and "padding"). This may mean that a relatively large amount of variation in the level of abstraction - abstract generalizations used with more concrete illustrations and examples - will be conducive to effective communication from student to teacher, and at the same time may indicate that the material is really comprehended - the use of abstract generalizations showing that the relationships involved are understood, and the concrete examples showing that the generalizations themselves are understood.

We end up with the proposition that both the level

of abstraction (A_L index) and the degree of variation in this level should be correlated with academic achievement, since they may be indicative of an ability to perceive, assimilate and communicate academic material. We may extend this to include non-verbal achievement as well as the verbal achievement with which these measures are most concerned. Since, to a certain degree, much the same abilities, as measured by the A_L index and the degree of variation, may be involved in both verbal and relatively non-verbal performance³, we should be able to correlate these measures, taken from a sample of individuals writing, with achievement on mathematics, physics, etc. Whether we are concerned with verbal or non-verbal achievement, "It may well be, as Goldstein has so vigorously and persuasively suggested, that people are differentially set to handle the events they encounter, some seeking constantly to form conceptual groupings, others to deal with events in terms of simple identity categories..."(Bruner et al, 1956, p.57). And finally, as Miner(1957) puts it "...the level to which the other abilities are developed depends in part upon the level of the capacity for communication"(p.23).

³ The underlying factors leading to effective verbal communication may also lead to effective communication of quantitative material.

CHAPTER 111

THE VARIABLES USEDA. The Level Of Abstraction Formulas

Although the formula for the level of abstraction used is the one devised by Gillie, both the Flesch and the Gillie methods are outlined here, partly because the Gillie formula was derived from the Flesch, and partly because certain procedural considerations (discussed in Chapter 1V) have required that the Flesch be used also, but only in a minor way.

1. The Flesch

"To adapt the technique of readability to the measurement of the level of abstraction, the writer utilized the fact that certain parts of speech are more frequent in abstract expression, while certain other parts of speech are more frequent in concrete expression. It is well known for instance, that an abstract style contains relatively more descriptive adjectives, indefinite pronouns, and subordinating conjunctions, while a concrete style contains relatively more proper nouns, limiting adjectives, finite verbs, personal pronouns and co-ordinating conjunctions" (Flesch 1950). Flesch analyzed the generally accepted grammatical categories of the parts of speech, and chose those that were statistically related to concreteness. These were arbitrarily termed

"definite words" and the percentage of definite words became the measure of the level of abstraction, ranging from fully abstract (0%) to fully concrete (100%).

Through a process of trial and error, the following categories of definite words were chosen:

1. Common and proper nouns with natural gender; common and proper nouns specifying time; nouns in the possessive case ending in "s or s"; and nouns modified by the limiting adjectives listed below.

2. The following limiting adjectives: possessive adjectives, intensifying adjectives, the adjectives what, this, these, that, those, each, same, both; and the if modifying a noun not otherwise modified.

3. Finite verbs, except the verb to be used as a copula.

4. Present participles ending in ing if used to form the progressive tense.

5. The following pronouns: the relative pronouns who, whose, whom, what, that; interrogative pronouns, and the listed limiting adjectives when used as pronouns; personal pronouns, and reflexive pronouns.

6. The following adverbs: here, there, now, then, where, when, why, how.

7. All interjections.

8. The words yes and no.

The formula for the level of abstraction thus becomes

A_L = % of definite words.

Flesch reports that, while the more concrete material is more readable, this measure is not actually a measure of readability, but of abstraction.

2. The Gillie

Because of the complexity of the Flesch abstraction formula, Gillie (1957) proposed a new formula, using two Flesch categories - definite articles and finite verbs - and a new category - nouns of abstraction. A multiple regression equation using the Flesch formula as the criterion yielded

$$AL = 36 + DA + FV - 2NA$$

where DA = definite articles/200 words
FV = finite verbs/200 words
NA = nouns of abstraction
/200 words

" Multiple R for the formula is .8229. R of this size indicates that the formula will, on the average, give results very nearly equal to the Flesch abstraction formula Since this formula was derived in part from the Flesch abstraction formula, and since the total Flesch formula was used as the criterion for its validation, the formula cannot be presumed to be any more valid as a measure of abstraction than the Flesch formula" (Gillie 1957).

Because the Gillie formula is used here, the complete instructions for its application are given.

1. Count the number of definite articles and their nouns per 200 words. Count both the article the and the noun it modifies, but only if that noun is a single word not otherwise modified, either by an intervening adjective or by a clause or phrase following the noun. Do not count the when modifying adjectives or noun-adjectives as in the best, the Irish.

2. Count the number of finite verbs per 200 words. Count all the verbs of any tense which are in the first, second or third person and which have subjects either expressed or understood. Do not count non-finite verb forms or verbals. In verb forms with auxiliary words, count the auxiliary rather than the main verb. Do not count any form of the verb to be (is, was, are, were, will be, have been, etc.) when used only as a copula to link the subject with a predicate complement.

3. Count the number of nouns of abstraction per 200 words. Count all nouns ending in the suffixes ness, ment, ship, dom, nce, ion, and y, including the plurals of such nouns. Count nouns ending in y even when it is the end of a longer suffix like ity or ology, but not when used as a diminutive.

Reliability of the Abstraction Formulae

No data has been reported on the reliability of either of the formulae. However, because of their similarity to the readability formulae, we may expect that scorer reliability at least is high. Since the Gillie formula is used in this study, a split-half reliability coefficient was determined. A random sample of 50 papers (out of 95) was chosen and the A_L index for the first 100 words was correlated with the index for the second 100 words.¹ The obtained r was .59, which, when substituted in the Spearman-Brown Prophecy Formula², was increased to .74. This represents what the reliability of the whole test should be if each half were 200 words long.

Validity of the Formulae

Only indirect evidence concerning the validity of the indexes is available. Flesch of course, on the basis of his experience, states that his formula was designed to measure verbal abstraction, and as such, is a quantification of the semanticists more general abstraction ladder. In addition to this general statement, Jenkins and Jones (1951) say that the formula is useful for measuring abstraction per se,

¹ Each sample used in this study consisted of 200 consecutive words from material described in Chapter IV.

²
$$r_{tt} = \frac{2r_{hh}}{1 + r_{hh}}$$

although their reasons are not reported. Actually, it would appear that both the Flesch and Gillie formulas do measure abstraction, but to what extent we cannot really say. Still, perhaps a consideration of the Gillie measure, used here, may be useful. Take the first category - definite articles and their nouns. Under this category, the expressions the car and the vehicle (not otherwise modified) are both scored as being concrete and are equally weighted, whereas vehicle is certainly a higher order concept than car. Furthermore, the expression the red car is not counted as concrete (and is therefore a contributor to abstractness) while the vehicle is, in spite of the fact that the latter is again a higher order concept. Now consider the third category - nouns of abstraction, which are scored as abstract. Such nouns as triangularity, redness etc. are clearly no more abstract than fear, joy, or wealth. Instead of referring to degree of abstractness, it would appear that they refer to the quality that serves to relate one object to another of the same class. For instance, it is triangularity that is common to all triangles. Apparently the noun of abstraction is the verbalization of the relationship between a class of objects, and as such takes into account only the fact that such a relationship is signified, and not the

degree of abstractness of the relationship. In the same way, the red car expresses a particular relationship - redness - that exists between the objects in the class car; ie. what this car has in common with certain other cars (besides carness). The expression the red car then, becomes a separate concept, with the relationship that makes it a concept being explicitly expressed. In other words a new concept has been formed from two others - carness and redness. For example, take the sentence "The car crashed into the wall." There are only two concepts here (forgetting "crashed into") - car and wall, and the A_L index would be very low (extremely concrete). Now if the sentence is changed to "The red car crashed into the wall," we have four concepts instead of two - wall, car, redness, and the concept of red cars. Although red is used as an adjective here, it certainly implies the concept of redness. The red car signifies a new class of **objects**, and so also qualifies as a concept. The A_L index now becomes higher, being more abstract than the previous sentence. It would appear then that the Gillie abstraction formula, may actually measure the degree to which concepts are used (or the number of concepts) as well as the order of concepts used. Presumably the number and order of concepts used would be highly related, though no empirical evidence

is available to justify this presumption. At any rate, since it seems that A_L measures both the level of abstraction and the degree to which concepts are employed, we will assume that it is a sufficiently valid measure for a theoretical investigation such as this one.

B. VARIATION

The degree to which written expression alternated between concrete and abstract levels was determined by computing the Gillie A_L score for each of the first ten consecutive sentences in the material selected for analysis. Then the average change (regardless of direction) in score from one sentence to the next, was taken as the measure of variation. For example, suppose the A_L scores for four consecutive sentences were 60, 20, 35, and 70. The total change in scores is $40 + 15 + 35 = 90$, and the average change is 30. Gillie has recommended however, that for A_L to be meaningful it should be computed from a sample of at least 200 words so that variations are averaged out. But the point here is that we wish to measure this variation and to use it as another variable. It should be realized though, that undue weight may be given to short sentences and that the measure is relatively a crude one.

C. THE SCHOOL AND COLLEGE APTITUDE TEST

The criterion of intelligence used is the School and College Aptitude Test (SCAT), published by the Cooperative Test Division, Educational Testing Service. It was specifically designed to "measure school-learned abilities directly, rather than psychological characteristics or traits which afford indirect measurement of capacity for school learning", the primary purpose being "to aid in estimating the capacity of a student to undertake the next higher level of schooling" (SCAT Manual). Five forms are available, covering the various grade levels, with Form 3A (Grade 9 level) being used here.

The test consists of 110 multiple choice questions, 60 in the Verbal section, and 50 in the Quantitative section.

Verbal

Part 1 - Sentence completion (comprehension of the "sense" of a sentence).

Part 3 - Vocabulary (attachment of meanings to isolated words).

Quantitative

Part 2 - Arithmetic reasoning (the manipulation of numbers and the application of number concepts accurately).

Part 4 - Routine computation (the solving of quantitative problems).

Scores for either the Verbal, Quantitative, or Total may be used. No data on validity or test-retest reliability are reported. However, an analysis of internal consistency revealed reliability coefficients of over $+ .90$ for the Verbal, Quantitative and Total scores. Estimated correlations between the SCAT and ACE are given as around $+ .89$ for the SCAT V and ACE L, $+ .75$ for the SCAT Q and ACE Q, and $+ .88$ for total scores.

D. THE CRITERIA

The criterion for academic performance used in this study is the final grade 12 average obtained by students enrolled in the matriculation program in the Alberta high schools. This average is made up of the departmental examinations, which include English 30, Social Studies 30, Mathematics 30, Biology 32, Physics 30, Latin 30, French 30, German 30, and Chemistry 30. The grade given in any one of these courses depends solely upon the final examination, which is not graded by the individual teacher, but by the Department of Education. The lowest score on an examination is given the value of 0 and the highest score a value of 100. The remaining scores are transformed to this scale (0 to 100) in such a way that the distribution of marks is as follows:

80 - 100	-	5%
65 - 79	-	20%
50 - 64	-	35%
40 - 49	-	25%
0 - 39	-	15%

The distribution is therefore not quite normal.

However, it is assumed that the distribution of final averages is approximately normal. Each final average used was composed of marks from at least three courses, one of which was English 30.

Since the sample of writing used was taken from the English 30 paper, the English 30 grade may be termed a secondary criterion of academic performance, being especially useful in testing the role of A_L and the Variation in verbal communication.

CHAPTER IV

PROCEDURE

The population from which the sample was taken consisted of all Grade 12 students enrolled in the Alberta matriculation program for the year 1958-59 who:

1. Wrote at least three departmental finals, one of which was English 30.
2. Had taken the SCAT while in Grade 9 (1956).
3. Wrote on a given essay topic on the English 30 paper.

The SCAT was first given to Grade 9 students in 1956, and by using only those students who had taken this test, the sample was comprised of students who had the same number of years of high school (3) and who had at least 4 years of study in Alberta schools. This latter point ensured that the sample would not contain subjects who had only recently learned the English language. No attempt was made to control for cultural or socio-economic background, sex, or personality etc. since, although these factors may be influential, it was not felt that their importance was great enough to justify the additional labor that their inclusion would have entailed. On the English paper (Part A)¹ three possible essay topics were available, two of which required the reproduction of material learned during the school year, and one of

¹ The English examination consists of two separate papers A and B, the former being concerned with Poetry, Drama and an original essay.

which was "Are extracurricular activities worthwhile in the high school?" Although any one of these topics could have been used in the sample, since we are assuming that an individual takes a characteristic and consistent approach in his writing, the more general topic quoted above was chosen. This ensured that the influence of rote memorization and regurgitation would be at a minimum, and that the individual's own style would be used as much as possible.

The actual sample was selected so as to approximate a normal distribution with a mean of 60, a standard deviation of 14, and an N of 100. The mean and standard deviation were very similar to the population parameters.² Errors in selection were responsible for reducing the sample N from 100 to 95. Although the sample was chosen so as to be normal, the selection of subjects for each portion of the distribution was random.

The sample then, consisted of 95 English 30 examination papers. More precisely, it consisted of the first 200 consecutive words from the essay previously noted. Each paper was analyzed for the level of abstraction using both the Flesch and Gillie formulas. The original plan was to use only the Gillie because of its ease of application, but since the Flesch seemed better suited to the measurement of the variation in

² The sample and data used came from the Department of Education.

the abstraction level, it was decided to use it in place of the Gillie. While the papers were being analyzed however, it was realized that the particular nature of the essay topic gave extreme emphasis to one of the Flesch categories - personal and reflexive pronouns. Many students used a very great number of these pronouns, probably because they involved themselves in the discussion. Since this may have made the passages spuriously high in concreteness it was decided to employ the Gillie measure after all. The Flesch was retained in a secondary capacity because it was thought that the use of the personal and reflexive pronouns might in itself be of some significance.

Change of scale

The Flesch and Gillie formulas are both designed so that the higher the score, the more concrete the passage. Because this might lead to needless confusion and would involve negative correlations, the obtained scores were subtracted from 100. This reversed the scale, so that the more abstract expression received the highest score, without changing the degree of any relationships which might be involved.

Once the papers had been analyzed and measures of abstraction and variation obtained, the distributions of the variables were tested for normality. It was

found that the distribution of raw scores for the SCAT V and Q, the Gillie AL, and the Variation were significantly skewed. The distribution of final averages was normal, since the selection procedure required it, and it was felt that the English 30 and the Flesch distributions were not so skewed nor so important to warrant changing them.

The other variables however, were transformed to normal distributions with a mean of 50 and a standard deviation of 10, by using McCall's T - scaling procedure.³ Concerning this procedure, Guilford (1950) says "We may not know that the population is normally distributed on a trait, but by normalizing distributions, where there is no inhibiting information to the contrary, we achieve more common and meaningful scores"(p.301).

³ The procedure for T - scaling was taken from Guilford (1950).

CHAPTER V

RESULTS ¹

Pearson product-moment correlations were computed between all the variables, with a visual inspection of the scattergrams indicating that the assumptions of linearity and homoscedasticity were probably tenable. The resulting intercorrelations are presented in Table I.

TABLE I. MATRIX OF INTERCORRELATIONS BETWEEN THE FINAL AVERAGE, ENGLISH 30, SCAT V, SCAT Q, VARIATION, GILLIE A_L, AND FLESCH A_L.*

VARIABLE	X ₀	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆
X ₀	-						
X ₁	.74	-					
X ₂	.63	.66	-				
X ₃	.61	.54	.44	-			
X ₄	.36	.19	.21	.12	-		
X ₅	.52	.44	.53	.32	.24	-	
X ₆	.32	.21	.32	.22	.39	.54	-

X₀ = Final average

X₁ = English 30

X₂ = SCAT V

X₃ = SCAT Q

X₄ = Variation

X₅ = Gillie A_L

X₆ = Flesch A_L

* $p < .05$ when $r = .21$

$p < .01$ when $r = .26$

¹ Raw data appears in the Appendix.

Table I indicates that A_L^2 and the Variation are significantly ($p < .01$) correlated with the criterion of academic achievement (Final average), and that A_L is also significantly correlated with intellectual ability as measured by the SCAT V and Q. This in itself would tend to demonstrate the validity of the hypotheses. However, to assess whether these variables actually contribute anything to the prediction of academic performance that the SCAT V and the SCAT Q alone do not, it was necessary to compute a set of beta coefficients and relative weights, using A_L , the Variation, the SCAT V and the SCAT Q as independent variables, and the Final average as the dependent variable. The calculations were carried out using the Doolittle method (Guilford 1950, p.441). The results are summarized in Table II.

The regression weights(column 4) are of special interest, for they tell us the proportion of variance in the criterion that can be accounted for or attributed to each independent variable. The sum of these regression weights is R^2 (actually $R_{0.2345}^2$), called the coefficient of multiple determination, since it indicates the proportion of variance in the Final average that is associated with or dependent

² The symbol A_L used alone refers to the Gillie A_L .

TABLE II. BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, WHEN THESE VARIABLES ARE USED TO PREDICT FINAL AVERAGE.

(1)	(2)	(3)	(4)	(5)
VARIABLE	r_{ok}	B_{ok}	$r_{ok}B_{ok}$	$\frac{r_{ok}B_{ok}}{-R_{o.k}^2} = b$
X_2 (SCAT V)	.63	.3287	.2077	.3425
X_3 (SCAT Q)	.61	.3875	.2365	.3899
X_4 (Var.)	.36	.2056	.0746	.1230
X_5 (A_L)	.52	.1697	.0876	.1446
			$\Sigma = .6065$	$\Sigma = 1.0000$
			$\Sigma = R^2$	

r_{ok} = correlation between the independent variable and the Final average (validity coefficient).

B_{ok} = beta coefficient

$r_{ok}B_{ok}$ = regression weight - proportion of the total variance in the Final average that is accounted for by the independent variable.

b = relative weights - proportion of the total predictive variance (R^2) accounted for by each independent variable.

upon the independent variables combined with the regression weights used. Since $R^2 = .6065$, we can say that 60.65% of the variance in our criterion of academic achievement is accounted for by whatever is measured by the SCAT V and Q, A_L , and the Variation. Note that R^2 is the sum of the regression weights; we use these regression weights to determine the proportion of the variance in the Final average that is accounted for by each of the independent variables. Thus, we can say that the SCAT V and the SCAT Q account for 20.77% and 23.65% of the total variance in the Final average, and that the Variation accounts for 7.46% and A_L for 8.76%. The relative weights (b) indicate the proportion of the predictive variance attributed to each variable. To determine whether the variance accounted for by A_L and the Variation is significant, it was necessary to compute new sets of beta coefficients, leaving out first the Variation and then A_L . Then the predictive variance obtained using all four variables ($R_{0.2345}^2$) was compared to that obtained when the Variation is left out ($R_{0.235}^2$) and when A_L is omitted ($R_{0.234}^2$). The significance of the differences between these variances was ascertained using the F test, the results being shown in Table III.

TABLE III. THE TOTAL VARIANCE IN FINAL AVERAGE ACCOUNTED FOR WHEN THE SCAT V AND Q, VARIATION, AND A_L ARE USED AS INDEPENDENT VARIABLES, AS COMPARED TO WHEN THE VARIATION OR A_L IS OMITTED.

INDEPENDENT VARIABLES	PREDICTIVE VARIANCE	F-RATIO ³	p
X_2, X_3, X_4, X_5	.6065	9.00	<.01
X_2, X_3, X_5	.5669		
X_2, X_3, X_4, X_5	.6065	7.73	<.01
X_2, X_3, X_4	.5725		

X_2 = SCAT V

X_3 = SCAT Q

X_4 = Variation

X_5 = A_L

$$^3 F = \frac{R_1^2 - R_2^2}{1 - R_1^2} \cdot \frac{m_1 - m_2}{N - m_1 - 1}$$

where R_1 is the multiple r based on m_1 independent variables, and R_2 is the multiple r based on m_2 variables selected from m_1 .

Table III indicates that both the Variation and A_L account for a significant ($p < .01$) proportion of the variance in the criterion, the Final average. The conclusion is that each of these variables adds something to the prediction of the Final average that the SCAT V and Q do not, at least under the conditions of this study.

Although the investigation is primarily a theoretical one, and as such not especially concerned with the actual prediction of grades, it should be of interest to compare the multiple correlation coefficients obtained when the Variation and A_L are used alone and in combination with the SCAT V and Q. These are listed in Table IV.

TABLE IV. MULTIPLE CORRELATION COEFFICIENTS⁴ OBTAINED BETWEEN THE CRITERION (FINAL AVERAGE) AND SEVERAL COMBINATIONS OF INDEPENDENT VARIABLES.

	PREDICTIVE VARIANCE(R^2)	R
$R_{0.23}$	.5330	.72
$R_{0.45}$	.3271	.57
R_{Q25}	.4620	.67
$R_{0.234}$	.5725	.75
$R_{0.235}$	.5669	.74
$R_{0.2345}$	.6065	.77

⁴ All multiple r's have been corrected for shrinkage.

It is interesting to note that the addition of the Variation and A_L to the SCAT V and Q only results in increasing R from $+.72$ to $+.77$. The increase is small but significant, and although it may be of little value in prediction it is of considerable value in a theoretical study.

It will be recalled that a decision had been made earlier to include the Flesch index of abstraction to see if A_L^{it} accounts for any of the variance in the criterion that A_L does not. Accordingly, a new set of beta coefficients was computed using the Flesch in addition to the other four independent variables. The results, presented in Table V, indicate that the addition of the Flesch only raises the predictive variance from $.6065$ to $.6075$, an increase that is not significant ($p > .05$). It is therefore dropped from further consideration with the conclusion that it does not add anything to the prediction of the Final average that is not already covered by the other independent variables, especially the Gillie A_L . But before proceeding, we might note a rather interesting thing about Table V. The Flesch is given a negative regression weight even though it is positively correlated with the criterion and with the other independent variables, an indication that, even though

TABLE V. BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, AND THE FLESCH A_L , WHEN THESE VARIABLES ARE USED TO PREDICT FINAL AVERAGE.

(1)	(2)	(3)	(4)	(5)
VARIABLE	r_{ok}	B_{ok}	$r_{ok}B_{ok}$	$\frac{r_{ok}B_{ok}}{R_{O.k}^2} = b$
X_2 (SCAT V)	.63	.3288	.2078	.3421
X_3 (SCAT Q)	.61	.3905	.2384	.3924
X_4 (Var.)	.36	.2260	.0819	.1348
X_5 (A_L)	.52	.2047	.1058	.1742
X_6 (FLESCH)	.32	-.0779	-.0264	-.0405
			$\Sigma = .6075$ $= R^2$	$\Sigma = 1.0000$

r_{ok} = correlation between the independent variable and the Final average (validity coefficient).

B_{ok} = beta coefficient

$r_{ok}B_{ok}$ = regression weight - proportion of the total variance in the Final average that is accounted for by the independent variable.

b = relative weight - proportion of the total predictive variance (R^2) accounted for by each independent variable.

not significant, it may be acting as a "suppressor" variable, tending to suppress or cancel out some of the irrelevant elements in the other independent variables. Note in particular, that its inclusion raises the regression weights of the SCAT Q, the Variation and A_L , the increase being most marked with the A_L (see Table II). Had the Flesch resulted in a significant increase in the predictive variance in the Final average it would have been discussed further.

Part of the theoretical basis for this study was concerned with the possible role of A_L and the Variation in the effective communication of academic material. The very fact that the Final average is partly comprised of subjects that are relatively quantitative in nature precludes the possibility of using it to properly evaluate the function of these variables in such communication. The English 30 paper, on the other hand, from which the Variation and A_L were taken, might serve rather well for the purpose, and for this reason another set of beta coefficients was developed using English 30 as the dependent variable. The results are presented in Table VI.

TABLE VI. BETA COEFFICIENTS, REGRESSION WEIGHTS, AND RELATIVE WEIGHTS FOR A_L , THE VARIATION, THE SCAT V AND Q, AND THE FLESCH ⁵, WHEN THESE VARIABLES ARE USED TO PREDICT ENGLISH 30 GRADES.

VARIABLE	r_{1k}	B_{1k}	$r_{1k}B_{1k}$	$\frac{r_{1k}B_{1k}}{R_{1.k}^2} = b$
<hr/>				
X_2 (SCAT V)	.66	.4748	.3134	.5957
X_3 (SCAT Q)	.54	.3033	.1638	.3105
X_4 (Var.)	.19	.0645	.0124	.0236
X_5 (A_L)	.44	.1343	.0591	.1129
X_6 (FLESCH)	.21	-.1045	-.0219	-.0426
<hr/>				
			$\Sigma = .5266$	$\Sigma = 1.0000$
			$= R^2$	

r_{1k} = correlation between the independent variable and English 30 grades.

B_{1k} = beta coefficient

$r_{1k}B_{1k}$ = regression weight - proportion of the total variance in English 30 grades that is accounted for by the independent variable.

b = relative weight - proportion of the total predictive variance (R^2) accounted for by the independent variable.

⁵ The Flesch was included through an oversight. However, its influence upon the other variables was not considered serious enough to warrant computing new weights.

As might have been expected, the SCAT V accounts for the bulk of the predictive variance (b) in English 30 grades. Somewhat less expected is the relatively minor, albeit significant ($p < .01$)⁶ contribution of A_L to the prediction of English 30 grades, especially since it was of considerable importance in accounting for the variance in the Final average. Both the Variation and the Flesch account for an insignificant proportion of the predictive variance. Note that the Flesch again has a negative weighting.

A brief summary of results is given in Table VII.

⁶ F - Ratio = 7.15

TABLE VII. SUMMARY OF THE RESULTS MOST RELEVANT TO THE INVESTIGATION.

DEPENDENT VARIABLE	INDEPENDENT VARIABLES	b	R ²	R	σ _R
FINAL AVERAGE	SCAT V	.3425	.6065	.77	.04
	SCAT Q	.3899			
	VARIATION	.1230			
	A _L	.1446			
ENGLISH 30	SCAT V	.5957	.5266	.71	.05
	SCAT Q	.3105			
	VARIATION	.0236			
	A _L	.1129			
	FLESCH	-.0426			

b = relative weight - proportion of the total predictive variance (R²) accounted for by the independent variable.

R = multiple correlation coefficient between the dependent variable and the independent variables.

σ_R = the standard error of R, given by the formula

$$\sigma_R = \frac{1 - R^2}{\sqrt{N - m}}$$

CHAPTER VI

DISCUSSION

Because this study is primarily a correlational one, several comments upon the interpretation of correlation coefficients may be required. Concerning correlation, Kenny and Keeping(1954) remark that "Although statistical theory gives us a description of the indicated relationship between two variables, the interpretation of the results abounds in pitfalls easily overlooked by the unwary"(p.300). One of the major pitfalls in question is the tendency to consider a correlation coefficient as being indicative of a causal relationship when there is no substantiating logical or empirical evidence available for doing so. When such evidence is lacking, as it so often is, the only legitimate inference able to be made is that a certain degree of relationship exists between the variables. This applies especially to the present study, since part of the theoretical discussion has implied that A_L and the Variation may be causal factors in the attainment of Grade 12 grades, at least to the degree that they play a role in effective communication and that such communication is of importance in obtaining grades. Unfortunately however, the nature of the hypotheses and procedure are such that significant

results will not demonstrate that academic achievement is dependent upon or caused by A_L and the Variation, but only that a certain degree of concomitance is present. Further research would be necessary to uncover the precise nature of the relationships involved. Of course, by demonstrating the tenability of our hypotheses, a first step is taken in this direction.

With this in mind we may consider the results obtained, which appear to be in agreement with the hypotheses presented. From the matrix of intercorrelations (Table I) we find that both A_L and the Variation are significantly correlated with the criterion of academic achievement - the Final average - and also that A_L is significantly correlated with intellectual ability as measured by the SCAT V and Q. This means that the hypotheses have been validated under the conditions of this study and at the .01 level of significance. But to understand the possible meanings and implications of these findings, some additional considerations are necessary.

Table IV showed that the SCAT V and Q used together yield a multiple correlation with the Final average of $+ .72$. Part of the reason for this high coefficient lies in the fact that the SCAT V and Q were

used separately rather than as one test as is usually the case; and since they both have high validity coefficients and a low intercorrelation, they result in a substantial multiple r . Somewhat more surprising than these results is the observation that the level of abstraction in written expression, as measured by the Gillie A_L has a correlation with the Final average of $+.52$, a value higher than many intelligence and scholastic aptitude tests are able to obtain. In this regard, Panabaker(1954) found a correlation of only $+.42$ between the Laycock Mental Ability Test and the final grade 12 average obtained by a sample of Calgary high school students. When A_L is combined with the Variation, a multiple r of $+.57$ results, a rather respectable coefficient under the circumstances. Although these values may be spuriously high and only apply to the conditions of this study, and to the particular sample and population used, they do seem to suggest that where intelligence test scores are not available some indication of the individual's subsequent academic achievement may be gained from the level of abstraction and degree of variation in this level, contained in his written expression. As a matter of fact, the validity coefficients for these variables may possibly be considerably higher had they been

corrected for attenuation, since the split-half reliability for A_L has been estimated at only $+.74$, and the Variation would presumably be as low. By combining all four independent variables - the SCAT V and Q, the Variation and A_L -into a battery, the multiple r is maximized at $.77$, and although the SCAT V and Q alone have a validity of $+.72$ the addition of either the Variation or A_L results in a significant increase in the predictive variance in the Final average. Thus, both A_L and the Variation contribute something to the prediction of final grade 12 grades, over and above what they have in common with the SCAT V and Q and with each other.

A thought somewhat disturbing to the theory developed for this study, is that A_L may be more of an elaborate measure of working vocabulary than a measure of the level of abstraction. This stems largely from the observation that one of the categories used in the computation of A_L - the nouns of abstraction - tends to involve words that are relatively rare.¹ It is very unlikely that the other two categories - definite articles and their nouns, and finite verbs - reflect vocabulary, providing a certain minimum is available, as it almost certainly is in the population from which

¹ According to the Thorndike and Lorge(1942) word counts.

the sample was drawn. However, the correlation between A_L and the SCAT V, which is mostly a vocabulary recognition test, is $+.53$, a value which becomes $+.64$ when corrected for attenuation. We might therefore assume that vocabulary and A_L are related. On the other hand, there is some evidence, though meagre, that A_L may depend more upon the manner in which the individual's working vocabulary is employed rather than upon sheer vocabulary size and upon the ability to use difficult and obscure words. To test the possibility that the individual who uses nouns of abstraction that are comparatively rare also obtains a high A_L score, a Spearman rank correlation was computed between A_L and the average frequency of occurrence per million words of the nouns of abstraction used by each individual.² A correlation of $r_s = -.09$ was observed, indicating that A_L is probably not a measure of the rarity or difficulty of words used (assuming a certain minimum vocabulary is available for use). This is not really too surprising, since a noun of abstraction is generally nothing more **than** a rather common word with a certain suffix attached.³ Under the circumstances therefore, we will retain our original

² N = 30. Word frequency was obtained from the Thorndike and Lorge(1942) word counts.

³ See Chapter III, p. 27.

assumption that A_L measures the level of abstraction of writing, and the ability to perceive and use relationships.

Although the criterion of academic achievement in this study has been set as the Final average, the manner in which A_L and the Variation are related to performance on the English 30 paper is also considered here, since it has been suggested in the theoretical discussion that these variables may play a part in effective communication; and the English paper is one in which such communication should be of considerable importance. Reference to Table VI (p.48) proves to be enlightening in this regard. As might have been expected, the SCAT V accounts for most of the predictive variance in English 30 grades (59.57%); the SCAT Q accounts for 31.05%, the Variation for 2.36%, and A_L for 11.29%. This represents a marked change from the situation in which the Final average is the dependent variable. For instance, in accounting for the variance in the Final average the SCAT Q is of more importance than the SCAT V even though the SCAT V has a slightly higher validity coefficient. The reason for this is that the intercorrelations of the SCAT Q with the other independent variables are lower than are those of the SCAT V.

But where English 30 grades are concerned, the much higher validity coefficient of the SCAT V (+.66 as compared to +.54 for the SCAT Q) more than offsets this. Of more direct concern is the relationship of A_L and the Variation to English 30. Although A_L correlates +.44 with English 30 grades and accounts for a significant proportion (11.29%) of its predictive variance, it is less important in the prediction of these grades than in the prediction of the Final average, which includes several quantitative subjects. Perhaps the fact that English 30 grades are partly dependent upon such things as spelling, grammar and punctuation has reduced the degree of the relationship between these grades and A_L . At any rate, it appears that the level of abstraction in written expression may be related to the "quality" of this expression, and also to performance that is relatively quantitative (in so far as the Final average is partly comprised of quantitative subjects). This may reflect a general underlying factor (or factors) that is important in all academic performance. Its quite possible that this factor is largely "general intelligence", but at the same time we have seen that A_L has something to contribute that the SCAT V and Q have not; still, perhaps the A_L measures intellectual ability not

measured by the SCAT V and Q. It would have been rather interesting to correlate A_L with a test that has been specifically designed to measure Spearman's "g" (say, the Raven Progressive Matrices Test, or even the Laycock Mental Ability Test) since A_L , like these tests, has been assumed to be measuring the ability to perceive relationships. This brings us back to the study by MacKinney and Jenkins(1954).⁴ Apparently, just as the complexity of written material able to be understood is related to the complexity of material produced, so also may the degree to which higher order concepts and relationships are used in written expression (and measured by A_L) be related to the ability to perceive and comprehend relationships and concepts. Whether the significant correlation of A_L with both English 30 grades and the Final average in grade 12 indicates that it plays an important role in the effective communication from student to teacher, or whether it is reflective of a general ability to perceive and assimilate conceptual events, we cannot say. Both possibilities were suggested in the theoretical discussion; and as long as the findings of this study have not invalidated the hypotheses derived from

⁴ See Chapter I, p.7.

said discussion, we may accept the hypotheses as being tenable at the .01 level of significance. Unfortunately however, this does not demonstrate the tenability of the theory - the hypotheses may be valid for entirely different reasons.

Considering now the Variation in the level of abstraction, we find that it does not appear to be of much importance in performance that is highly verbal in nature, for it correlates only $+ .19$ with English 30 grades and accounts for only 2.36% of the predictive variance in this subject, neither value being significant. It is very unlikely that such a low relationship could be explained away on the basis of poor spelling, punctuation etc. since the effect of these things could hardly have been so marked as to confound any relationship which may actually exist. If the degree of Variation present in writing does actually measure the degree to which abstract generalizations and concrete examples are alternated, then we are unable to accept the hypothesis that such alternation is a significant factor in obtaining grades in English 30; it might further be doubted that it plays much of a role in the effective communication of academic material which is highly verbal in

character. Unfortunately these remarks are only as valid as the measure of alternation used. But whether or not the Variation is valid (in the manner suggested in the theory), it has turned out to be a rather interesting variable. Its correlation of $+.36$ with the Final average is almost as high as that reported by Panabaker(1954) using the Laycock MAT, and at the same time its low intercorrelations with the SCAT V and Q, and with A_L , may mean that it is a relatively pure variable. Further, it is hardly correlated at all with the SCAT Q ($+.12$) and yet it correlates $+.36$ with a criterion made up largely of quantitative subjects - mathematics, chemistry, physics and biology. Perhaps this means that the degree to which an individual varies the level of abstraction in his written expression is related to his ability to comprehend and use the type of relationships and concepts that are of importance in the more quantitative areas. For instance, the use of abstract generalizations and concrete examples in writing may be attended by an ability to understand and use formulas and equations (generalizations) and to see how these are related to more specific and concrete data. This leads to the following question; does the relatively high correlation of A_L and the

Variation with the final grade 12 average represent a relationship with general academic achievement, as the theory developed earlier suggests, or does it reflect a high correlation with one or two of the subjects that make up the final average? If the latter were the case, and the particular subjects concerned were quantitative to a large degree, a multiple regression equation of high predictive value might be developed using the SCAT Q, A_L , and the Variation as independent variables. But regrettably, the scope of this study did not include a consideration of each grade 12 examination subject, and the answer to the question must therefore await subsequent research.

Although the results of this investigation have not demonstrated that A_L and the Variation are not involved in effective verbal communication, we are inclined to believe that these variables, especially the Variation, actually take a comparatively minor part in the effective communication of academic material. It seems more probable that they reflect, as the theory has implied, a general ability to perceive, assimilate and effectively use higher order concepts and relationships. At the risk of again becoming somewhat overly speculative, we might suggest that this ability is in turn related to the particular approach used by the

individual in conceptualization. The work of Goldstein (1941, 1948) Hanfmann and Kasanin(1937) and others,⁵ has shown that a given individual may display a rather consistent pattern of behavior and of approach to the formation of concepts. Three main patterns are generally listed: 1) concrete, 2) abstract, 3) alternating abstract-concrete. The available evidence seems to indicate that an abstract approach may be more efficient than a concrete one, and that an alternating abstract-concrete approach may be most efficient of all, in conceptualization. This last mentioned approach probably corresponds to the "active-search" theory of concept formation mentioned in Chapter I. If a given individual has a tendency to employ a particular approach in the formation of concepts, it may be that he displays much the same pattern in all his behavior, much as Buseman's (1935) "actionale" types tend to use active or dynamic expressions to describe everything, even dull landscapes.⁶ Should this be so, the level of abstraction and the degree of alternation in this level may be related to academic achievement simply because they are part of a general behavioral pattern that results in the effective assimilation of knowledge.

⁵ Several relevant studies are listed in Chap. I, pp.13-15.

⁶ See Chapter I, p.6.

CHAPTER VII

CONCLUSIONS

The primary objective of this study has been to test the hypotheses that: 1) the level of abstraction in written expression and the degree of variation in this level are related to academic achievement, and 2) the level of abstraction is related to intellectual ability. Under the conditions of this study, and using the Gillie formula as the measure of abstraction, the average change in abstraction from one sentence to the next as the measure of variation, the SCAT V and Q as the criterion of intellectual ability, and the final grade 12 average as the criterion of academic achievement, the hypotheses are accepted as being tenable at the .01 level of confidence. However, these conclusions only apply to the population from which the sample used in this study was drawn, viz. Alberta high school students who wrote at least three final examinations (including English 30) in 1959, were in a senior matriculation program, and who took the SCAT in 1956.¹ Very often in cases such as this, the tendency to generalize beyond the boundaries of the investigation makes itself felt. Nevertheless, the temptation is resisted, since the study has been essentially an exploratory one and therefore generalization must

¹ And perhaps those who selected the given essay topic.

await subsequent research and validation.

SUGGESTIONS FOR FURTHER RESEARCH

The results obtained seem significant enough to warrant further research designed specifically to follow up and extend the present findings and to test the many theoretical assumptions made herein. This would make it possible to determine whether the present assumptions and theory are sufficiently valid to be retained, or whether they should be unceremoniously rejected in favor of better ones; in which case we would be left with the consolation that our assumptions were at least amenable to verification. Thus, subsequent investigation might enable the following pertinent questions to be answered:

- 1) How valid and reliable are the Gillie formula for the measure of the level of abstraction, and the measure of variation in this level?

- 2) Do these variables reflect the type of approach used in the formation of concepts?

- 3) Are these variables related to effective communication of academic and other material; to personality factors?

- 4) Is the pattern of verbal abstraction in individuals' written expression part of an overall general behavioral pattern?

- 5) What is the relationship of these variables to academic

achievement^{at} the various educational levels and to specific subjects and courses?

Perhaps the finding most worthy of being followed up is the rather good correlation between the level of abstraction in writing and intellectual ability as measured by the SCAT. We have seen that A_L correlates $+0.53$ with the SCAT V, and $+0.32$ with the SCAT Q. As an afterthought, A_L was correlated with the SCAT total score, an r of $+0.57$ being obtained. The same was done for the Variation, r being $+0.23$. Then, by correlating A_L and the Variation with the SCAT total, a multiple r of $+0.63$ was found. However, if we correct for attenuation, the correlation between A_L and the SCAT total is increased to $+0.68$, and the multiple r to $+0.72$. If we had an estimate of the reliability of the Variation, its correlation with the SCAT and with A_L could also be corrected for attenuation, and although the correlation with A_L would thereby be increased (tending to decrease the multiple r), so also would the correlation with the SCAT. We might therefore expect that with both A_L and the variation so corrected, the multiple r with the SCAT total would be at least $+0.72$, and possibly higher. But unfortunately, this imposing figure depends upon several assumptions being met, and since it is in fact unlikely that they are met,² we might be well advised to

² See McNemar(1957), p.160.

consider the multiple r of $+.63$ as being the more likely. This is still high enough to suggest that a systematic investigation, using large samples, and requiring each individual to write 500 to 1000 words on a standard theme might turn up some interesting and practical findings. Such an investigation would of course avoid some of the limitations of the present study. Thus,

- 1) attempts would be made to determine the validity and reliability of the variables employed.
- 2) socio-economic status, cultural background, personality, educational and occupational level of parents, sex, interests, etc. would be controlled for, and may even be used as variables.
- 3) a test of intellectual ability would be given at the same time that the sample of writing was obtained; this would ensure that the testing conditions were standardized.
- 4) some efforts would be made to determine the actual significance of academic achievement.

But even though these and other limitations were obvious in the present study, the results obtained appear to be significant and meaningful. This of course does not necessarily mean that the theoretical framework and discussion are themselves meaningful. As we mentioned earlier, the hypotheses may be tenable for completely different reasons than those posited here. This is where further research becomes necessary.

BIBLIOGRAPHY

1. Allport F., and Walker L. (1934). Written Composition And Characteristics of Personality. Arch. Psych., 26, No. 173.
2. Boder D.P. (1940). The Verb-Adjective Qoutient: A Contribution to The Psychology of Language. Psych. Record, 20, 310-343.
3. Bruner J., Goodnow J., and Austin G. (1956). A Study of Thinking . New York: Wiley and Sons.
4. Buseman A. (1925). Die Sprache Der Jugend Als Ausdruck Der Entwicklungrhythmik. Jena.
5. Chase Stuart. (1954). The Power of Words. New York: Harcourt Brace and Co.
6. Chotlos J. (1944). Studies in Language Behavior. Psych. Monogr. 56, 75-111.
7. Deutsche J.M. (1937). The Development of Childrens' Concepts of Causal Relations. Minnesota Institute of Child Welfare, Monogr. Series,
8. England G.W., Thomas M., and Paterson D. (1953). Reliability of Flesch Reading Ease Formulas. Journal App. Psych., 37, 111-113.

9. Ewert P.H., and Lambert J.F. (1932). The Effect of Verbal Instructions Upon the Formation of Concepts. Journal Gen. Psych., 6, 400-413.
10. Flesch Rudolf. (1943). Marks of Readable Style. New York: Teachers' College, Columbia University.
11. _____. (1946). The Art of Plain Talk. New York: Harper and Bros.
12. _____. (1948). A New Readability Yardstick. Journal App. Psych., 32, 221-233.
13. _____. (1949). The Art of Readable Writing. New York: Harper.
14. _____. (1950). Measuring the Level of Abstraction. Journal App. Psych., 34, 384-390.
15. Gillie P.J. (1957). A Simplified Formula For Measuring Abstraction in Writing. Journal App. Psych., 41, 214-217.
16. Goldstein E. (1948). Language And Language Disturbances. New York: Grune and Stratton.
17. Goldstein E. ,and Scheerer. (1941). Abstract and Concrete Behavior: An Experimental Study With Special Tests. Psych. Monogr. 53, No. 239.

18. Gray W.S., and Leary B.E. (1935). What Makes a Book Readable. Chicago: Univ. of Chicago Press.
19. Guilford J.P. (1950). Fundamental Statistics in Psychology and Education. New York: McGraw - Hill Book Company Inc.
20. Hanfmann E., and Kasanin J. (1937). A Method For The Study of Concept Formation. Journal Psych. 3, 521-540.
21. Hayakawa S. (1949). Language in Thought and Action. New York: Harcourt, Brace and Co.
22. Hayes P., Jenkins J. and Walker B. (1950). Reliability Of The Flesch Readability Formulas. Journal App. Psych., 34, 22-26.
23. Humphrey G. (1951). Thinking: An Introduction To Its Experimental Psychology. New York: John Wiley and Sons, Inc.
24. Jenkins J. and Jones R. (1951). Flesch's Measuring The Level Of Abstraction. Journal App. Psych. 35, 68.
25. Johnson G.R. (1930). An Objective Method Of Determining Reading Difficulty. Journal Educ. Res. 20, 283-287.
26. Johnson W. (1946). People In Quandaries: The Semantics Of Personal Adjustment. New York: Harper and Bros.

27. Korzybski A. (1933). Science And Sanity. Lancaster P.A.: Science Press Printing Co.
28. Laycock S.R. (1933). Laycock Mental Ability Test. Saskatoon: University Of Sask. Bookstore.
29. Lockman R.F. (1956). A Note On Measuring Understandability. Journal App. Psych. , 40, 195-196.
30. MacKinney A. and Jenkins J. (1954). Readability Of Employees' Letters In Relation To Occupational Success. Journal App. Psych., 38, 26-30.
31. McCall W.A. (1939). Measurement. New York: MacMillan.
32. McNemar Q. (1957). Psychological Statistics. New York: John Wiley and Sons, Inc.
33. Miller G.A. (1951). Language And Communication. New York: McGraw - Hill.
34. Miner J.B. (1957). Intelligence In The United States. New York: Springer Publishing Co., Inc..
35. Panabaker H.E. (1954). The Relationship Of The Laycock Mental Ability Test To Success In High School. Unpublished Master's Thesis, University of Alberta.

36. Peterson G.M. (1932). An Experimental Study Of The Ability To Generalize. Journal Gen. Psych., 6, 90-114.
37. Peterson J.P. (1956). Comparison Of Flesch Readability Scores With A Test Of Reading Comprehension. Journal App. Psych., 40, 35-36.
38. Piaget J. (1926). The Language And Thought Of The Child. New York: Harcourt, Brace and Co.
39. Powers R.D. (1954). Sampling Problems In Studies Of Writing Style. Journal App. Psych., 38, 105-108.
40. Reichard, Schneider and Rapaport. (1944). The Development Of Concept Formation In Children. Amer. Journ. Ortho-Psychiatry, 14, 156-162.
41. Rimoldi H.J.A. (1951). The Central Intellective Factor. Psychometrika, 16, 75-101.
42. Russel D.H. (1956). Childrens' Thinking. New York: Ginn and Company.
43. Sanford F.H. (1942a). Speech And Personality. Psych. Bul., 39, 811-845.
44. _____. (1942b). Speech And Personality: A Comparative Case Study. Character and Personality, 19, 169-198.

45. SCAT Technical Report. Cooperative Test Division, Educational Testing Service, Princeton, N.J.
46. Spearman C. (1942). Theory Of General Factor. Brit. Journ. Psych., 36, 117-131.
47. Stern W. (1925). (title unknown). Zach. f. Paed. Psych., 26, 110-112.
48. Super D.E. (1949). Appraising Vocational Fitness. New York: Harper.
49. Swanson C. and Fox H. (1951). Validity Of Readability Formulas. Journal App. Psych., 35, 157-159.
50. Thorndike E. and Lorge I. (1942). The Teachers' Word Book Of 30,000 Words. New York: Columbia University.
51. Thorndike E. (1947). The Psychology Of Punctuation. Amer. Journal Psych., 60, 588-597.
52. Vernon P. (1936). The Matching Method Applied To Investigations Of Personality. Psych. Bull., 33, 149-177.
53. Vinacke W. (1951). The Investigation Of Concept Formation. Psych. Bull., 48, 1-31.
54. _____. (1952). The Psychology Of Thinking. New York: McGraw - Hill.

55. Vogel M. and Washburne C. (1928). An Objective Method Of Determining Grade Placement Of Childrens' Reading Material. Elem. Sch. Journ., 28, 373-381.
56. Wechsler D. (1944). The Measurement Of Adult Intelligence. Baltimore: The Williams and Wilkins Co.
57. Weigle E. (1941). On The Psychology Of So-Called Processes Of Abstraction. Journ, Abnor. Soc. Psych., 36, 3-33.
58. Welch L. and Long L. (1940). A Preliminary Investigation Of Some Aspects Of The Hierarchal Development Of Concepts. Journal Gen. Psych., 22, 359-378.
59. _____. (1942). Influence Of Levels Of Abstraction On Reasoning Ability. Journal App. Psych., 13, 41-59.
60. Yule G. (1938). On Sentence Lengths As A Statistical Characteristic Of Style IN Prose: With Application To Two Cases Of Disputed Ownership. Biometrika, 30, 363-390.

APPENDIX

TABLE I. THE SCORES OBTAINED BY EACH STUDENT ON
THE DEPENDENT AND INDEPENDENT VARIABLES. *

STUDENT	FINAL AVERAGE	ENGLISH 30	SCAT			FLESCH A _L	GILLIE A _L	VARIATION
			V	Q	TOT.			
1	27%	51%	36	47	59	67	51	39
2	29	37	33	30	45	70	42	36
3	34	41	22	48	48	63	26	58
4	35	43	38	40	56	66	46	25
5	36	47	51	43	76	71	46	57
6	38	44	44	43	68	75	26	54
7	57	61	50	44	76	79	58	60
8	57	68	54	58	90	73	52	54
9	55	46	45	35	65	73	50	54
10	53	59	36	52	63	74	41	39
11	56	55	46	50	77	68	42	46
12	55	56	39	45	61	77	36	67
13	91	73	72	72	107	76	69	44
14	91	84	65	72	104	73	58	52
15	84	83	63	62	99	64	38	64
16	85	86	57	67	96	78	63	67
17	84	93	73	50	98	70	69	60

* The scores for the SCAT V and Q, the Gillie A_L, and the Variation have been transformed to a distribution having a mean of 50 and a standard deviation of 10.

TABLE I (continued)

STUDENT	FINAL AVERAGE	ENGLISH 30	SCAT			FLESCH AL	GILLIE AL	VARIATION
			V	Q	TOT.			
18	83	90	64	55	96	78	67	67
19	63	71	57	47	84	67	34	42
20	64	71	63	60	98	78	57	47
21	63	72	63	49	91	68	62	54
22	63	66	45	58	81	71	53	63
23	59	55	52	52	84	79	51	36
24	58	55	69	49	95	75	56	76
25	59	62	43	49	72	72	38	36
26	58	50	44	45	71	70	46	40
27	57	59	51	52	83	75	57	59
28	59	64	44	52	75	64	46	36
29	59	55	34	41	53	65	41	48
30	59	46	44	53	77	66	30	72
31	58	50	57	40	79	74	57	64
32	60	75	47	55	81	78	56	59
33	58	47	48	57	83	79	60	53
34	62	61	44	58	80	69	45	48
35	60	47	40	60	75	68	50	52
36	58	58	47	35	67	73	34	62
37	57	66	57	38	78	73	61	48
38	69	50	43	58	78	74	52	57
39	68	86	52	65	91	64	41	49

TABLE I (continued)

STUDENT	FINAL AVERAGE	ENGLISH 30	SCAT			FLESCH A _L	GILLIE A _L	VARIATION
			V	Q	TOT.			
40	70	66	52	52	84	76	54	62
41	68	75	55	47	83	76	62	53
42	69	59	52	50	83	74	52	53
43	69	65	57	47	84	76	57	33
44	72	64	59	55	92	77	66	52
45	68	81	48	50	79	68	50	44
46	72	80	57	53	89	65	48	42
47	69	78	55	58	91	85	64	57
48	77	86	58	45	84	85	75	67
49	76	73	69	57	99	77	56	59
50	74	80	47	35	67	81	57	64
51	73	73	55	58	91	76	72	39
52	72	62	58	60	94	78	51	52
53	75	83	68	40	87	61	47	36
54	75	73	60	65	98	70	56	49
55	77	61	53	62	91	78	57	52
56	77	72	41	52	70	71	45	52
57	78	72	59	67	98	71	45	52
58	79	92	68	72	106	32	69	62
59	78	71	60	65	98	81	61	57
60	82	66	45	52	77	64	47	47
61	79	69	63	55	95	80	51	64

TABLE I (continued)

STUDENT	FINAL AVERAGE	ENGLISH 30	SCAT			FLESCH A _L	GILLIE A _L	VARIATION
			V	Q	TOT.			
62	56	72	60	53	92	70	44	42
63	53	71	50	50	81	75	59	44
64	54	64	41	47	65	56	52	42
65	55	44	37	47	60	65	44	47
66	54	53	38	50	56	65	56	52
67	64	64	62	52	92	76	56	46
68	64	71	45	67	85	77	54	52
69	63	83	50	53	83	74	53	46
70	63	42	38	44	59	78	63	57
71	64	79	63	55	95	73	65	48
72	64	50	42	48	69	78	63	53
73	43	68	40	53	68	63	32	38
74	45	29	36	30	48	63	25	39
75	43	50	45	55	79	74	50	48
76	44	62	51	60	88	71	34	34
77	50	62	50	44	76	68	45	44
78	52	59	40	35	55	68	59	58
79	48	44	46	41	70	80	48	49
80	48	58	57	48	85	69	54	53
81	51	51	46	55	80	70	45	44
82	51	44	39	41	58	72	51	53
83	50	64	55	50	86	76	48	39

TABLE I (continued)

STUDENT	FINAL AVERAGE	ENGLISH 30	SCAT			FLESCH A _L	GILLIE A _L	VARIATION
			V	Q	TOT.			
84	48	37	28	49	54	66	42	47
85	49	53	59	34	77	72	51	64
86	52	55	59	58	94	74	39	39
87	43	62	42	36	62	65	53	42
88	44	55	49	43	74	68	47	29
89	41	44	53	47	81	62	56	39
90	38	36	40	25	49	68	26	49
91	41	32	29	41	99	69	39	40
92	38	42	49	38	71	69	46	54
93	37	44	43	41	66	78	52	49
94	44	37	44	43	69	78	47	48
95	54	71	47	43	72	78	56	46

	Mean (untransformed)	S.D. (untransformed)
Final average	59.59	14.18
English 30	61.42	14.65
SCAT V	40.40	10.73
SCAT Q	37.97	6.34
SCAT total	78.40	14.69
Flesch A _L	27.77	5.46
Gillie A _L	49.44	9.16
Variation	25.56	9.09

B29785